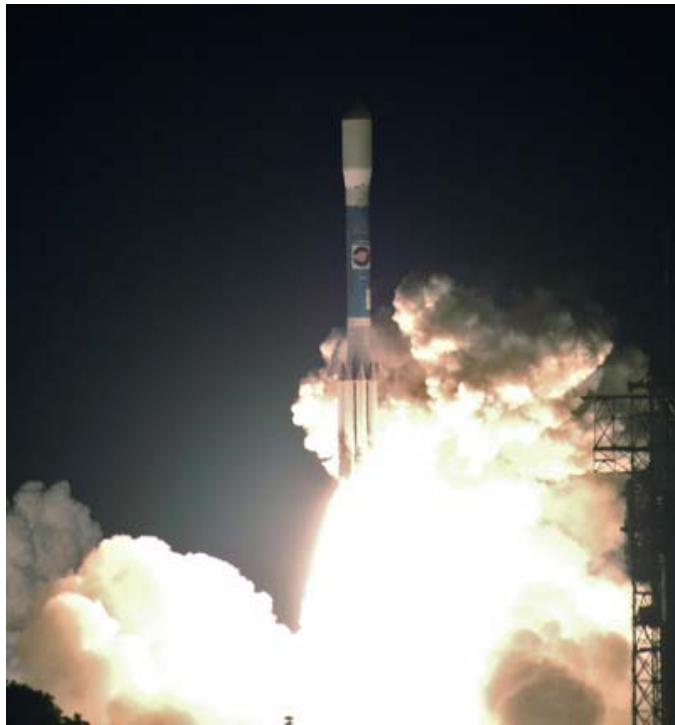


STEREO: Organizational Cultures in Conflict

The STEREO A (Ahead) and B (Behind) observatories were successfully launched from Cape Canaveral, Florida, on October 26, 2006, at 8:52 p.m. for a mission of at least two years.

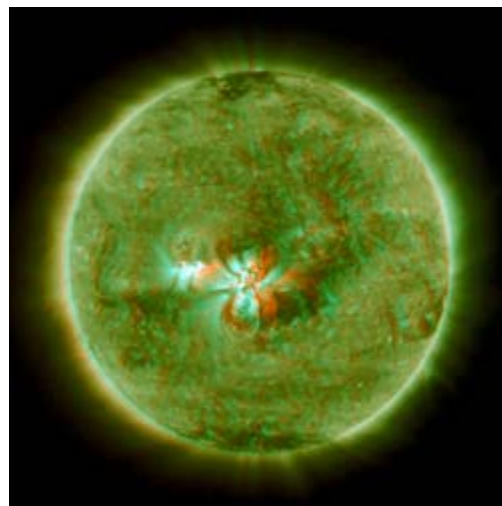
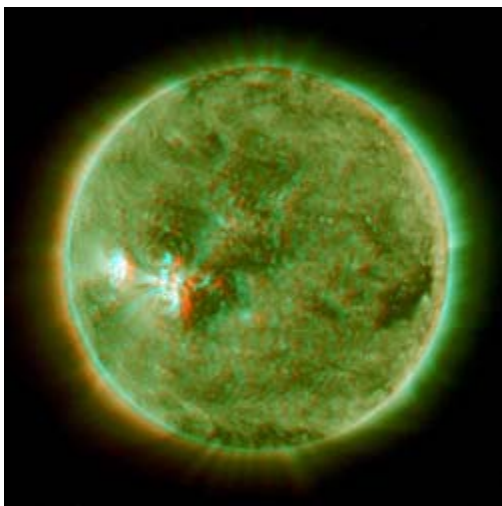
The original launch target of February 2006 slipped owing to a succession of problems, the most significant involving Boeing's second-stage oxidizer tanks for its *Delta II* 7925 launchers. Boeing engineers discovered that a tank at their Decatur, Alabama, plant identical to that being used for the STEREO launch was leaking as a result of metal thinness. All such tanks had to be checked, which meant the STEREO launcher was destacked and the tank checked from the inside. Verification, restacking, and refilling resulted in a three-month delay. Other delays included an earlier hydrazine propellant leak, instrument development difficulties, battery issues, and the usual launch-window considerations.



STEREO liftoff from Cape Canaveral Air Force Station, October 26, 2006. NASA image

On October 26, launch day, the *Delta II* lifted the two craft into highly elliptical geocentric orbits, their apogees reaching the Moon's orbit. On December 15, 2006, during the fifth orbit, the pair swung by the Moon for a gravitational swingby maneuver. At that point, STEREO A ejected to a heliocentric orbit inside Earth's orbit, while STEREO B remained temporarily on a high Earth orbit. STEREO B encountered the Moon again on January 21, 2007, ejecting it from Earth's orbit in the opposite direction of STEREO A. STEREO B entered a heliocentric orbit outside Earth's orbit, with the result that A and B completed their respective sun orbits in 347 and 387 days respectively. With STEREO A moving faster and going closer to the Sun, the two craft together produce stereoscopic, 3-D pairs of images.

At a news conference on April 23, 2007, NASA unveiled 3-D anaglyph video and images of the Sun that had been acquired by the STEREO craft.



By combining images taken almost simultaneously from the A and B spacecraft, researchers have generated a 3-D sequence of images that track an active solar region over about a one-week period. The images were all taken in the 171 Angstrom wavelength of extreme ultraviolet (UV) light. Active regions, which are areas of intense magnetic activity, appear brighter in UV light. The region is seen moving from left to right as the Sun's rotation carries it along. Arcing loops above the active region reveal million-degree Celsius particles spinning along magnetic field lines. These images can be viewed with red and cyan 3-D glasses. NASA image

On February 25, 2007, there was an eclipse of the Moon when it crossed the face of the Sun, but it could not be seen from Earth. It could be seen, however, from the STEREO B spacecraft in its orbit around the sun, but trailing behind the Earth. STEREO B is approximately one million miles from the Earth, 4.4 times farther away from the Moon than we are on Earth. As a result, the Moon will appear 4.4 times smaller than what we are used to (but much larger than, for example, the planet Venus appeared when it transited the Sun as seen from Earth in 2004.) This alignment of STEREO B and the Moon was not just due to luck. It was arranged with a small tweak to STEREO B's orbit the previous December. This is quite useful to STEREO scientists for measuring the focus and the amount of scattered light in the STEREO imagers and for determining the pointing of the STEREO coronagraphs. The sun as it appears in the images and each frame of the movie is a composite of nearly simultaneous images in four different wavelengths of extreme ultraviolet light that were separated into color channels and then recombined with some level of transparency for each. To put STEREO's success into perspective, Dr. Michael Kaiser,

STEREO project scientist from Goddard Space Flight Center (GSFC), said: “The improvement with STEREO’s 3-D view is like going from a regular x-ray to a 3-D CAT scan in the medical field.”

The instruments’ more accurate images are anticipated to have great scientific possibilities. “With STEREO’s 3-D imagery, we’ll be able to discern where matter and energy flows in the solar atmosphere much more precisely than with the 2-D views available before. This will really help us understand the complex physics going on,” said Dr. Russell Howard of the Naval Research Laboratory, principal investigator for the SECCHI suite of telescopes on the spacecraft. The images are more precise and they shed light on what scientists could only model before. Dr.

Madhulika Guhathakurta, STEREO program scientist at NASA HQ, said that the STEREO craft are able to image solar disturbances “the entire way from the Sun to the Earth. Currently, scientists are only able to model this region in the dark, from only one picture of solar disturbance leaving the Sun and reaching only a fraction of the Sun–Earth distance.”



Eclipse of the Moon as seen by STEREO B. NASA image

The STEREO observatories have performed to expectations and are being fine-tuned throughout the mission for imagery of even greater scientific impact. Before it could get that far, though, the project management team had to overcome some partnership issues. According to Mark Jarosz, STEREO observatory manager, “After the first review, Nick [Chrissotimos, project manager] said, ‘No, we’re a Goddard project, we’re managing it.’ A light switch went off, and changed the mindset.” This attitude might have come from differing attitudes from senior management at both GSFC and NASA HQ: One wanted GSFC to take a hands-off approach, the other wanted GSFC to take a more active oversight role. “In the end,” Chrissotimos said, “GSFC had to play a more active management role.” The important management lesson for Chrissotimos was that a project “should not come down to ‘you’re a contractor’ or ‘you’re a partner.’ It should be what’s best for the project.”

Ed Reynolds, the STEREO project manager for Applied Physics Laboratory (APL), offers a similar perspective:

Before we got there [to a point of open communication], communication was being controlled through a bottleneck at APL—to control the project. We worked really hard to get that communication open, and trust started to be established. One of the ways [we opened communication] was that there were times when we needed a skill set and we went to Goddard and said, “Can you provide it?” We were trying to launch New Horizons at the same time and we were really stretched. It wasn’t like they were writing negative reports about our skills. That really helped establish the trust.

The coinciding attitudes of the GSFC and APL project managers allowed the team to work together effectively and build a relationship of trust and communication. In summary, the GSFC–APL team found a way to break its cultural paradigm lock. Open, frank discussion at the team’s offsite meeting led to the agreed-upon “top-line principles” that broke the impasse and led to stunning mission success.